

CLAIMS:

1. An electrochemical cell, said cell having a positive electrode, a negative electrode and an electrolyte, characterised in that at least the positive electrode comprises a mesoporous structure having a periodic arrangement of substantially uniformly sized pores of cross-section of the order of 10^{-8} to 10^{-9} m.
2. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode is formed of a material selected from a metal, a metal oxide, a metal hydroxide or a combination of any two or more of these.
3. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises a metal and a metal oxide or hydroxide, said metal oxide or hydroxide forming a surface layer over said metal and extending over at least the pore surfaces.
4. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises a metal selected from: nickel; alloys of nickel, including alloys with a transition metal, nickel/cobalt alloys and iron/nickel alloys; cobalt; platinum; palladium; and ruthenium.
5. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises a metal oxide, hydroxide or oxy-hydroxide selected from: gold oxide; palladium oxide; nickel oxide (NiO); nickel hydroxide (Ni(OH)₂), nickel oxy-hydroxide (NiOOH) and ruthenium oxide.
6. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a pore diameter within the range from 1 to 10 nm, preferably from 2.0 to 8.0 nm.
7. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a pore number density of from 4×10^{11} to 3×10^{13} pores per cm^2 , preferably from 1×10^{12} to 1×10^{13} pores per cm^2 .

8. An electrochemical cell according to any preceding claim, wherein at least 85 % of the pores in the mesoporous structure have pore diameters to within 30 %, preferably within 10 %, more preferably within 5 %, of the average pore diameter.
9. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a hexagonal arrangement of pores that are continuous through the thickness of the electrode.
10. An electrochemical cell according to claim 9, wherein the hexagonal arrangement of pores has a pore periodicity of in the range from 5 to 9 nm.
11. An electrochemical cell according to any preceding claim, wherein the negative electrode comprises a mesoporous structure having a periodic arrangement of substantially uniformly sized pores of cross-section of the order of 10^{-8} to 10^{-9} m.
12. An electrochemical cell according to any preceding claim, wherein the mesoporous structure is a film having a thickness in the range from 0.5 to 5 micrometers.
13. An electrochemical cell according to any preceding claim, wherein the negative electrode comprises a material selected from: carbon; cadmium; iron; a palladium/nickel alloy; an iron/titanium alloy; palladium; and the mixed metal hydride LaNi_5H_x .
14. An electrochemical cell according to any preceding claim, wherein the negative electrode comprises a material selected from carbon and palladium.
15. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises nickel and an oxide, hydroxide or oxy-hydroxide of nickel selected from NiO , $\text{Ni}(\text{OH})_2$ and NiOOH , said nickel oxide or hydroxide forming a surface layer over said nickel and extending over at least the pore surfaces, and the negative electrode has a mesoporous structure of carbon or palladium.
16. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises nickel and an oxide, hydroxide or oxy-hydroxide of nickel selected from NiO , $\text{Ni}(\text{OH})_2$ and NiOOH , said nickel oxide

or hydroxide forming a surface layer over said nickel and extending over at least the pore surfaces, and the negative electrode comprises nanoparticulate carbon.

17. An electrochemical cell according to any preceding claim, wherein the cell is constructed to function as a battery, as a supercapacitor or as a combined battery/supercapacitor.

18. A portable electronic device containing an electrochemical cell according to any preceding claim.